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ABSTRACT

This training manual provides information needed to meet the minimum EPA standards for certification as a commercial applicator of pesticides in the industrial, institutional, structural and health related pest control category. The text discusses the use and safety of applying pesticides to control invertebrate and vertebrate pests such as ants, fleas, ticks, beetles, birds, and rodents. (CS)

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COMMERCIAL PESTICIDES APPLICATOR MANUAL:

INDUSTRIAL, INSTITUTIONAL, STRUCTURAL AND HEALTH RELATED

This manual was adapted for Virgin Island needs from materials furnished by the Training Branch, Operations Division, Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. It supplements the EPA/USDA publication: "APPLY PESTICIDES CORRECTLY - - A GUIDE FOR COMMERCIAL APPLICATORS." That publication should be read first.

The information herein provides a base to use in preparing for the certification examination in the category of INDUSTRIAL, INSTITUTIONAL, STRUCTURAL AND HEALTH RELATED PEST CONTROL.

Reference to commercial products or trade names is made with the understanding no discrimination is intended and no endorsement is implied by the College of the Virgin Islands Cooperative Extension Service.

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December, 1975

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COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS
(Acts of May 8 and June 30, 1914)
Agricultural Extension Service, College of the Virgin Islands
and the United States Department of Agriculture, Cooperating
D. S. Padda, Actg. Director

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COMMERCIAL PESTICIDES APPLICATOR MANUAL:

INDUSTRIAL, INSTITUTIONAL, STRUCTURAL AND HEALTH RELATED

William D. Fitzwater and Robert Renes

The U.S. Environmental Protection Agency has set the following standards for commercial applicators engaged as professional pest control operators in urban and residential sectors:

"Applicators must demonstrate a practical knowledge of a wide variety of pests including their life cycles, types of formulations appropriate for their control and methods of application that avoid contamination of food, damage and contamination of habitat, and exposure of people and pets. Since human exposure, including babies, children, pregnant women, and elderly people, is frequently a potential problem, applicators must demonstrate practical knowledge of the specific factors which may lead to a hazardous condition, including continuous exposure in the various situations encountered in this category. Because health related pest control may involve outdoor applications, applicators must also demonstrate practical knowledge of environmental conditions particularly related to this activity."

PEST CONTROL AND PESTICIDES

Consideration of factors limiting the reproductive and survival potential of each pest is the key to effective pest control. This usually involves the use of pesticides, but the removal of food, water, and a place to live are very important considerations. These, when integrated with appropriate chemical controls, usually provide a more lasting control.

As in all pest control situations, the applicator must first determine the type of pest he is dealing with. Recognition of the pest gives one a knowledge of damage potentials and the life cycle as well as an insight to the possible control measures. When the use of chemical pesticides are indicated, one must read the label carefully to select the pesticide best suited to that particular situation.

USING PESTICIDES SAFELY

Pest control specialists must not allow pesticides to be released into the soil, water, or air except where intended. Displaced pesticides are pollutants and can cause serious damage and loss. Applicators must be particularly aware of sensitive areas, such as food handling establishments and areas where young, elderly, or ill persons are located. Applicators working in this category come in closer contact with the public and all the problems

such a relationship involves than most other pesticide users. Thus they must be particularly careful in their actions to avoid the possibility of any repercussions from thoughtless or unsafe acts.

The pest animals concerned are species able to adapt themselves to the extreme alterations of the human environment. This adaptability plus their close, every-day proximity to humans, makes control by environmentally safe and effective measures even more difficult to attain. Thus the applicator must be particularly aware of the identification, habits, and life cycles of these species to achieve the necessary degree of control.

The following is a brief summarization of current knowledge (see also identification aids in the Appendix) of invertebrate and vertebrate pests found in the Virgin Islands. This is admittedly the bare essential information and more detailed knowledge must be obtained from texts listed in the Appendix before an applicator can be considered truly qualified.

COCKROACHES

One of the most primitive forms of life and thus a very successful form competitive to man is the cockroach. While there are many species in the world, the following are the most common in the Virgin Islands.

Name	Description	Habits
American cockroach (Periplaneta Americana)	Reddish brown to dark brown. Adults 40-50 mm long.	Damp basements and sewers. Forage mostly on first floors of buildings.
Australian cockroach (Periplaneta australasiae)	Reddish brown to dark brown; yellow markings on thorax; yellow streaks at base of wing covers. Adults 25 mm.	Warm, damp places, in or out of doors; forage mostly on first floors of buildings.
Brown-branded cockroach (Supella supellectilium)	light brown. Mottled, red-brown on wings of female; lighter wings on male. Adults 13mm long.	Live all over a building. Flies readily when disturbed.
German cockroach (Blattella germanica)	Light brown. Black stripes running lengthwise on back. Adults 16mm long.	Live all over the building, but particularly in kitchens and bathrooms.
Oriental cockroach (Blatta orientalis)	Black or dark, brown. Vestiges of wings on females; short wings on males. 20-35mm long. More sluggish than other kinds.	Damp basements and sewers. Forage mostly on first floors of buildings.

Of the preceding species, the American, German and brown-banded are very common in the Virgin Islands. The Australian and oriental do occur but are not common.

Control

Before applying insecticides, explore the sanitation present. The destruction of breeding places and removal of food and water sources may reduce the need for chemical applications. The success of the latter is dependent upon proper application. In kitchens and living areas, apply the insecticide as a crack and crevice or spot treatment into hiding places. In food handling areas, only crack and crevice treatments can be made. Common "hide-outs" are behind and beneath built-in shelves and cabinets, in and beneath stoves and refrigerators, under sinks, behind baseboards, etc.. Cockroaches also hide beneath trash, old papers, in cupboards, washing machines, and shelves. For these places, best control can be obtained by treating the entire area. Always follow label directions and precautions.

Sprays are preferred to dusts because they are easier to apply and the deposits are invisible. Dusts, on the other hand, can sometimes be blown into places difficult to reach with a spray and have a longer residual if kept dry.

ANTS

Ants can be a problem in and around the home and other structures. Most species build their nests in the soil. Those that invade buildings usually nest near foundation walls or under concrete slabs.

During the year, ant colonies produce winged individuals. These are often mistaken for termites. However, ants have a narrow "waist" like a wasp; termites, a straighter body with no waist. Ants have four wings of unequal length that are clear like those of a house fly. Termites have four wings, but they are of equal length, twice as long as the body and milk-colored. Ants have elbowed antennae while termite antennae are straight.

The most common inside ants are: thief ant, pharaoh ant, odorous house ant and crazy ant. The most common outside ants are carpenter ant, fire ant, and acrobat ant. The latter are usually larger species.

Control

The secret to ant control, indoors or out, is direct treatment of the nests. In the case of carpenter ants, look for piles of sawdust to locate entries or find damaged wood. Then blow dust into the nesting area or holes. Other species may nest in soil around the foundation or out in the lawn. These can be controlled by applying an approved emulsion, wettable powder, or granular form of insecticide directly to the nest and surrounding area.

Houses built on concrete slabs often have serious ant problems. The insects nest under the slabs and enter through cracks and utility openings. Here, again, it is important to locate and destroy the nest.

However, if ants still get into the house, apply insecticides where the ants gain entry or hide - - at foundation walls, doorways, windowsills, baseboards, behind built-in cabinets and furniture, beneath heavy appliances. Residual sprays usually work best, although dusts may be more appropriate in some areas.

BEES AND WASPS

The Hymenopterous insects are often nothing more than nusiances, but they can also be dangerous to man as stings can kill sensitive individuals. Only the females are capable of stinging and this is usually done in "defense" (real or imagined) of their nests.

The paper wasps include the single comb wasps (Polistes), hornets, and yellow jackets. Polistes wasps and hornets build paper-like nests under eaves of houses, in shrubs, and other protected places. Hornet nests are easily recognized as the large grayish-brown paper structures usually seen hanging in trees or bushes. Yellow jackets normally build their nests underground.

Mud dauber wasps are so named because they build nests of mud in attics, eaves, and on other parts of buildings.

Bees (honey, bumble and carpenter) often become serious pests in and around buildings, not only because of the danger from stings but structural damage may result from their nest building activities. Honey bees may build in walls, chimneys and attics. Their combs may melt and ruin interiors. Old combs may become infested with other annoying insects. Carpenter bees may drill 13mm holes into exposed wood of buildings. The holes make a 90° turn below the surface and run with the grain of wood for distances up to 30cm.

Bumble bees and carpenter bees are often confused, but are distinguished by the yellow hair on the top of the abdomen of the bumble bee. Bumble bees build nests in straw, old rags or in any material that provides some insulation.

Control

Control of these species should be carried out after dark when the entire colony is in or on the nest.

Special protective clothing is needed when controlling paper wasps. Residual sprays work well, but they must be applied with a sprayer large enough to do the job quickly without getting too close to the nest. Dusts may be blown into the nest openings of yellow jackets.

Mud dauber nests can be eliminated simply by tearing down their nests as they do not defend them. This species rarely stings anyway.

Bees can be controlled with sprays, aerosols, or dusts of approved insecticides. These materials should be injected into the nest area. Again, it is wise to wear protective clothing when treating the nests.

BEDBUGS

The bedbug lives on the blood of warm-blooded animals like bats and birds as well as man. These insects hide in cracks and crevices during the day, coming out at night to feed. They are flattened, wide bugs that bloat with a blood meal.

Control

Residual sprays can be used for control, although dusts can be used in places under baseboards and door casings. Spraying must be thorough, but sprays should not come in contact with mattresses, etc. which will come in direct contact with humans.

FLEAS

Although there are numerous species of fleas, the cat and dog fleas being associated with pets, are those most frequently encountered in the home. These are small insects, without wings, who live on the blood of animals including humans. As they prefer pets as a normal host, the removal of these animals from a household will cause an increase in human attacks as new generations are born from the eggs laid by the previous ones. Both fleas are also intermediate hosts of the dog tapeworm.

Control

Permanent control involves ridding the pet of fleas using labeled sprays, flea collars or dusts and treating the premises with sprays. While the pest control specialist can treat the premises, the pet should be treated by the owner or veterinarian.

TICKS

A number of ticks feed on man and his animals, but the brown and American dog ticks are the ones that can become serious pests in the home. Here as in the case of fleas, the principal host is the dog. After feeding, these drop off their host and conceal themselves in any available hiding places like cove moldings, window frames, etc. Ticks carry many diseases to both man and his animals.

Control

Control efforts are mainly centered indoors. They are hampered by the many available hiding places and delayed hatching of eggs which may take up to five months. Thus more than one spray application to all infested premises may be necessary to completely eliminate the problem. Treat all cracks and crevices, moldings, baseboards, window and door frames, and similar places where ticks might conceal themselves. Pets should also be treated using pesticides available in drug stores and pet shops. Veterinarians also maintain dipping vats for treating tick-infested dogs.

MOSQUITOS

These dangerous, blood-sucking insects while being a considerable nusiance are the carriers of the most important vector-borne diseases today. They are best controlled on a widescale community basis rather than spot treatments.

MILLIPEDES AND CENTIPEDES

Millipedes have two pairs of short legs on each body segment and are under 5cm long. Centipedes have one pair of legs on each segment and are larger. While the latter have poisonous fangs only a few species are large enough to cause harm, however, both are nusiances when they occur around dwellings in large numbers.

Control

Invasion of houses can often be prevented by removal of leaves, compost and general refuse from around buildings and sealing any cracks in foundation walls and other openings. Spraying outdoors, especially around the foundation with a residual, is helpful, but repeat applications may be necessary.

FLIES

Flies are important pests not only as nusiances but as carriers of diseases (dysentery, diarrhea, food poisoning, and typhoid fever). The

house fly and black blow fly are the most common species encountered around the home. The latter is slightly larger and is a shiny black or green.

Control

Fly control is most successful when it includes a combination of good sanitation, screening, and the use of insecticides. Fly breeding areas such as garbage, pet manure, and all other decaying plant and animal matter should be removed. Residual sprays can then be applied outdoors to fly resting places. Poison baits can also be used but must be replaced and are best used to supplement a spray program. Indoor fly control is best accomplished by using a contact spray or aerosol or by the use of impregnated resin strips.

SILVERFISH

These are wingless, boat-shaped insects with three long "bristletails" at the end of the body. They feed on stored foods, paper, and most anything containing proteins and carbohydrates.

Control

Residual sprays applied to all hiding and resting areas are most frequently used for control, but dusts and baits may also be useful.

BOOKLICE

The tiny booklice or psocids are 1 to 2 mm long. They frequent damp places around stored foods, in crawl spaces under houses, and around books. As their food is microscopic molds and fungi they do no harm and are pests only by being present, often in great numbers.

Control

This can sometimes be accomplished by removing their food and moisture sources. Residual sprays in and around infested areas are also very effective.

SPIDERS

These are usually nusiances due to their webbing activities as contrary to common belief only the black widow spider is capable of inflicting injury to humans in the Virgin Islands. The female is marked with the distinctive red or yellow "hour glass" on the underside of the abdomen. It lives in undisturbed situations, such as under rocks and boards in and around buildings.

Control

Sanitation plus the use of a residual spray is the best control. Clean away all webbing with a vacuum cleaner and remove as many of their hiding places as possible.

FABRIC PESTS

Clothes moths and carpet beetles attack a variety of things, but they do the greatest damage to woolen products, furs, feathers, and hair. Infestations are common in boxes of old clothing, overstuffed furniture, woolen carpets and rugs, and piano felt. The damage is done by the larval stage, although the presence of adults in an area may be the first indication of an infestation. The carpet beetle adults are shiny black about 3mm long. They live outside around gardens, flower beds, etc. Larvae are carrot or cigar-shaped with a long brush of tail bristles. The webbing clothes moth is buff-colored with light reddish hairs on top of the head while the casemaking clothes moth is brown with three dark spots on each wing. The larval stage of webbing clothes moths usually spins

feeding tunnels of silk while the case-making clothes moth rarely spins any webbing, but does spin a small silken cell around itself that it carries while feeding.

Control

Prevention is a very important part of fabric pest control since one small hole in a suit or other fabric may completely ruin the item. Proper cleaning and storage is important. Dry-cleaning and moth-proofing solutions are effective for a limited period of time. Fabrics should be cleaned before being stored as the first instar larva of the clothes moth cannot survive on clean clothes. Liberally apply moth flakes or crystals to clothing being stored.

TERMITES

Termites are social insects having colonies in which there is a division of labor between different types of individuals. Nearly all species have reproductive and soldier castes, and many have a worker caste. If this is lacking, the nymphs handle the nest building and food gathering activities. These workers are responsible for the damage done to structures. Within the reproductive caste are winged individuals. These emerge from the colony and disperse to form new colonies. See under ANTS for a description of these winged insects.

Subterranean termites are so named because the colony is usually located below ground, with the workers moving into wood and wood products above ground where they eat the soft grain of the wood, leaving a thin shell outside. The presence of a colony can be detected by probing wood near the foundation with a screwdriver or by seeing earthen "shelter tubes" on foundation walls and wood. Termites build the tubes from bits of soil and excrement which they also use to close up breaks in the surface of infested wood. Termites need cellulose for food and soil for moisture so that wood in contact with soil is ideal. If this is not available they build those shelter tubes to maintain contact. Occasionally they can become established without soil contact where a leaky roof, air conditioner condensation, or pipes provide the moisture.

Dry-wood termites, unlike the subterranean, bore directly into wood, making their nests in the wood rather than below ground. They cut across the grain of the wood, excavating large chambers connected by small tunnels. Excretal pellets are a distinguishing characteristic. These are hard and have six distinct concave surfaces. They are pushed out of the colony through small holes in the wood. Their color varies with the type of wood being consumed.

Control - Subterranean

The basic principle of control is to break the connection between wood and soil (or other moisture sources). This can be done by a chemical or physical barrier across all possible points of entry.

Soil on both sides of exposed foundation walls and soil surrounding supports should be soaked with an approved termite control chemical at the rate of 15 liters per 3 meters per 30cm of depth. Application can be made by trenching or combination of trenching and rodding.

For outside basement walls, where the footing is deep, a V-shaped trench is dug against the wall at least a foot

deep to insure penetration to the footing. A perforated hollow rod is used to inject insecticide to the footing of the basement wall. When treating concrete block or brick foundation walls, the wall should be drilled above the grade line and all voids flooded with 8 liters of chemical per 3 linear meters.

Treating slab-based buildings involves saturating much of the soil underneath the slab. The chemical is injected either through holes drilled in the slab at 30cm intervals next to all foundation walls or by rodding from outside the building.

Control - Dry-wood

Since these do not require contact with soil but obtain their moisture from the air or wood, treatment is done by fumigating the entire structure with a toxic gas or introducing a toxic liquid or dust into the excavated chambers. Fumigation is a dangerous practice and must be done with all the safeguards prescribed on the label.

POWDER-POST BEETLES

Although there are several types, the most common ones fall into one of two groups: Lyctid or Anobiid powder-post beetles. They all damage wood in about the same manner. They are small beetles (5mm long) and reddishbrown to nearly black in color. The surface of the wood is perforated with numerous small "shot holes" about the size of pencil lead. Any slight jarring of the wood causes a fine, flour-like powder to sift from these holes. When cut or broken, the interior of the infested wood may reveal masses of this finely-packed powder. Joists, subflooring, hardwood sill plates, and interior trim are most frequently attacked.

Control

Infested wood is sprayed with an approved residual pesticide. All surfaces must be thoroughly wetted. Chamber fumigation is often used for furniture and other movable objects.

LONG-HORNED BEETLES

These large conspicious beetles (15 to 75mm) have long thin antennae which may be longer than the body. Eggs are laid on rough-sawed timbers or logs and the larvae (round-head borers) feed on the wood. They bore large oval-shaped holes as they move through it. The only species that will attack timbers in a building is the old-house borer.

Control

Infested timbers must be drilled and pressured treated to force the insecticide throughout the gallery system. Another method is fumigation where possible.

WOOD-DECAY FUNGI

Most decay or rot fungi grow only on wood which is subject to wetting by contact with moist soil, rain, or condensation, though some can conduct water directly to the wood. These are living plants that take their food directly from the wood, reducing its strength and often making it brown and crumbly.

Control

The use of fungicides or insecticides will not stop wood decay. Only by eliminating the moisture source can it be controlled. Preservatives may be used but only after the wood has dried. Remove the source of moisture by proper

drainage, ventilation, vapor barriers, and other good construction practices. If moisture is a chronic problem, construction timbers should be treated with preservative chemicals.

STORED PRODUCT PESTS

Many kinds of cereal and food products and other stored products may become infested with insects. These eat or contaminate the product making it unfit for human consumption. To eliminate infestations, it is necessary to find and identify the pest and then destroy or treat infested materials and the area where they are stored.

Control

The area of infestation should be thoroughly cleaned and then treated with a residual spray. After spraying, cover shelves with paper before replacing food or cooking utensils.

Grain and Flour Beetles

This group includes the confused and red flour beetles, saw-toothed grain beetle, cigarette and drugstore beetles. The last two are particularly common in the home. All of these are small, reddish-brown beetles less than 3mm. The larvae are yellowish-white with brown heads. Both adults and larvae will be found in infested material.

Grain Weevils

The granary and rice weevils have small legless grubs that feed and develop inside individual grain kernels. Adults have long snouts.

Cabinet Beetles

These are general scavengers though they prefer cereal grain products. The larval stages do most of the damage. Adults feed mainly on flower pollen outdoors but may sometimes be found on stored products. Adults feed mainly on flower pollen outdoors but may sometimes be found on stored products.

Indian Meal Moth

These small moths have a 15mm wingspread. The forewings are a coppery color on the outer two-thirds and a whitish gray at the basal end. Larvae are pinkish-white and web together the materials in which they feed. Adults fly about the site of the infestation.

Angoumois grain moth

Tiny moth is similar in size and color to clothes moths. However, it flys in the daytime whereas clothes moths shun the light. Larvae develop within whole kernels of grain, such as popcorn.

VERTEBRATE PESTS
RATS

Rats are extremely important pests in that they contaminate and destroy food products, damage furniture and buildings, carry numerous diseases and parasites, and often bite children and even adults. They are most adaptable to the extreme environmental changes man has made and are able to adapt their behavorial patterns to these changes.

There are two types of rats on the Islands: (1) Norway rats and (2) Roof rats. Norway rats live in burrows in the ground. They have a heavy, thickset body, small ears and a tail which is shorter than its head and body together. Roof rats are better climbers. Their bodies are more slender and they have large ears and a tail that is longer than the length of the head and body combined.

A knowledge of rat behavior is essential to successful control. You must know where the animals are living and their travel and feeding patterns. Next in importance to an attractive bait is proper placement of that bait. Baits (and traps) must be easily accessible to the animals and in the areas they are apt to be found.

Control

Longer lasting and complete control is possible only when food, water, and shelter sources necessary to the survival of a particular population are removed insofar as possible. This is done by removing available food and water supplies, rearranging storage to eliminate harborage, and completely closing off their access to some areas by "rat-proofing" with rat resistant materials. In the latter case, it is necessary to understand that rats can enter holes over 15mm, climb rough masonry walls and utility wires, crawl up pipes 35 mm in diameter or less, jump 1 m up in the air, and burrow at least the same distance underground.

When the best degree of sanitation and ratproofing has been attained, you can start reductional control measures. Poison baits are the most common approach and when done properly are very effective. There are two types of poisons: (1) single dose and (2) multiple dose or anticoagulant poisons. The first type is more toxic and kills with one feeding. These chemicals are more apt to have a distinct taste or quicker action that may result in bait shyness. The effects of the second type are cumulative so the animals continue eating the bait over a period of 3 to 14 days before they build up a lethal dose. These poisons are generally safer but more expensive to apply and there is evidence of resistant populations being developed world-wide.

While it is not necessary when using anticoagulants, best results with the single dose poisons are obtained by prebaiting with unpoisoned food of the type to be used in the poisoned bait for 3 or more days before treating.

All poison baits should be mixed, handled and exposed according to label directions in such manner as to be inaccessible to public and pets. They should be picked up along with the rat carcasses and disposed of in a safe manner.

In circumstances where poisons cannot be used, traps can be an effective alternative. While many types can be used, the common wooden base snap traps are the most readily available. These should be modified by enlarging the bait pan. When set perpendicular to rat runways they will catch rats as they pass over them. Use plenty of traps.

Poisonous gases can be used in outdoor burrows that are a distance from buildings. Label precautions should be followed.

HOUSE MICE

House mice are distinguished from small rats by their small eyes and feet. These may actually cause more damage than their bigger cousins as they are more inconspicious, can get in smaller openings (over 8mm), and their habit of nibbling contaminates more material than is actually destroyed.

Control

Mice differ from rats in that they have a much more limited range so that baits and traps should be set closer, within 3 meters of each other. Mice are also nibblers and will sam-

ple new foods more readily than rats. Therefore smaller and more numerous bait placements should be made. Mice like to run alongside walls and other objects as do rats so these are prime areas for baits and traps. Mouse-size snap traps should also have modified bait pans.

Traps and baits must be supplemented with good sanitation and "mouse-proofing" measures.

PIGEONS

Native doves and pigeons are protected by Federal laws, but the common pigeon is considered escaped poultry and can be killed when necessary. These pigeons become extreme nuisances on certain properties as well as damaging field crops. They also carry ornithosis, encephalitis, toxoplasmosis, Newcastle disease, salmonellosis, pseudo-tuberculosis, as well as various endoparasites. Their droppings are favorable growing places for various fungus diseases, aspergillosis, histoplasmosis, cryptococcus, etc.

Control

As in the case of rats, the removal of food, water, and shelter should be done insofar as practical. Roosts should be made untenable or inaccessible by screening, chemical or physical barriers. Trapping with bob-type or funnel openings can be used against limited numbers as can shooting where this is permissable. Poisoning with toxic or repellent chemicals is probably the most practical reductional method. Label directions should be followed carefully.

BATS

These winged mammals being insectivorous are mostly beneficial. However, when they roost under house eaves, roof tiles and other places on buildings, the odors and noise can become a great nuisance. They also present a health hazard as the droppings support fungal growth and the danger of rabies is ever present.

Control

Batproofing premises by screening and caulking (small bats can enter spaces as small as 10mm) is the recommended approach. Fumigation and toxic contact poisons can be used for lethal controls where bats are a demonstrated health hazard.

MONGOOSE

These Asian animals introduced under the mistaken concept they would control rats have become strongly established on St. Croix. They are a menace to poultry, ground nesting birds and other native fauna, and a serious rabies reservoir potential if the disease became established.

Control

While most rodenticides would work against these animals there are no

registered chemicals available. Control consists of protective netting for poultry and small steel jump traps.

APPENDIX - SUGGESTED REFERENCES

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HOUSEHOLD AND STORED-FOOD PESTS: KEY TO COMMON ADULTS

Harold George Scott & Chester J. Stojanovich

1 or 2 body *regions*

3 body regions

MITES

wings well developed

wings reduced or absent

with 3 long tails

without 3 long tails

SILVERFISH

antenna 4-7 segmented

antenna more than 7 segmented

SPRINGTAILS

front wings shell-like

front wings not shell-like

BEETLES–WEEVILS–BORERS–MEALWORMS

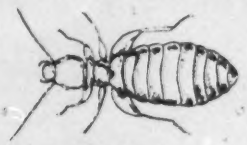
1 pair wings

2 pair wings

FLIES

tarsus 4-5 segmented

tarsus 1-3 segmented



PSOCIDS

wings with scales

MOTHS

wings without scales

COCKROACHES

with narrow waist

ANTS

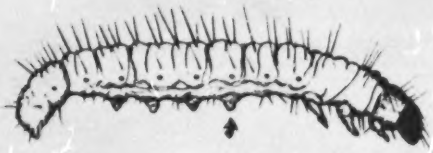
without waist

COCKROACHES

HOUSEHOLD AND STORED-FOOD PESTS: PICTORIAL KEY TO COMMON LARVAE

Chester J. Stojanovich & Harold George Scott

abdominal legs present

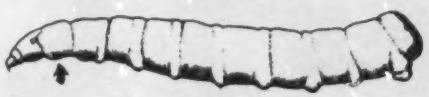


abdominal legs absent

MOTH LARVAE

thoracic legs present

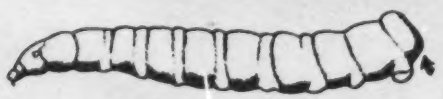
thoracic legs absent



BEETLE, BORER & MEALWORM LARVAE

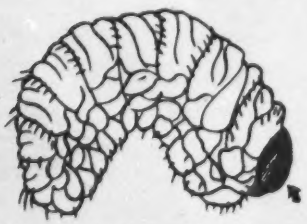
with fleshy lobes at ends of body

without fleshy lobes at ends of body



FLEA LARVAE

head capsule present



WEEVIL LARVAE

head capsule absent

MUSCOID FLY LARVAE

COCKROACHES: PICTORIAL KEY TO SOME COMMON SPECIES

Harry D. Pratt

SMALL, ABOUT 5/8" OR SHORTER

PRONOTUM WITH 2 LONGITUDINAL BLACK BARS

GERMAN COCKROACH
(Blattella germanica)

PRONOTUM WITHOUT LONGITUDINAL BLACK BARS

WINGS COVERING ABOUT HALF OF ABDOMEN PRONOTUM ABOUT 1/4 INCH WIDE

WOOD ROACH
(Parcoblatta spp.)

WINGS COVERING NEARLY ALL OF ABDOMEN OR EXTENDING BEYOND. PRONOTUM NARROWER

BROWN-BANDED COCKROACH
(Supella supellectilium)

MEDIUM TO LARGE, LONGER THAN 5/8 INCH

WINGS ABSENT, OR SHORTER THAN ABDOMEN

WINGS ABSENT

WINGS SHORTER THAN ABDOMEN

ORIENTAL COCKROACH
(Blatta orientalis)

WINGS COVERING ABDOMEN, OFTEN EXTENDING BEYOND

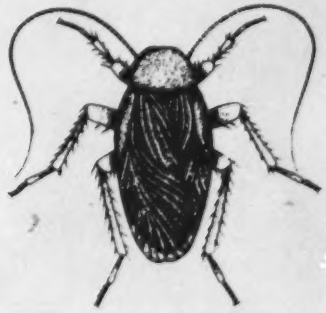
PRONOTUM MORE THAN 1/4 INCH WIDE

PRONOTUM ABOUT 1/4 INCH WIDE WITH PALE BORDER

WOOD ROACH
(Parcoblatta spp.)

FRONT WING WITHOUT PALE STREAK. PRONOTUM SOLID COLOR, OR WITH PALE DESIGN ONLY MODERATELY CONSPICUOUS

PRONOTUM SOLID DARK COLOR. GENERAL COLOR VERY DARK BROWN TO BLACK



SMOKY BROWN COCKROACH
(Periplaneta fuliginosa)

PRONOTUM USUALLY WITH SOME PALE AREA. GENERAL COLOR SELDOM DARKER THAN REDDISH CHESTNUT

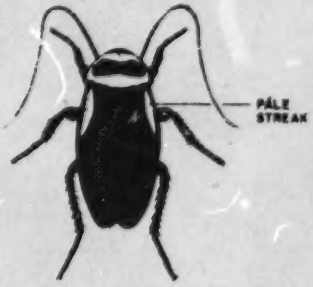
LAST SEGMENT OF CERCUS NOT TWICE AS LONG AS WIDE

BROWN COCKROACH
(Periplaneta brunnea)

LAST SEGMENT OF CERCUS TWICE AS LONG AS WIDE

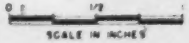
AMERICAN COCKROACH
(Periplaneta americana)

FRONT WING WITH OUTER PALE STREAK AT BASE. PRONOTUM STRIKINGLY MARKED



AUSTRALIAN COCKROACH
(Periplaneta australasiae)

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
Communicable Disease Center
Training Branch
Atlanta, Georgia – 1953



COCKROACHES: KEY TO EGG CASES OF COMMON DOMESTIC SPECIES

Harold George Scott, Ph.D. and Margery R. Borom

less than ¼" long subsegments apparent

more than ¼" long subsegments inapparent

with about 16 subsegments length more than twice width

Blatella germanica
GERMAN COCKROACH

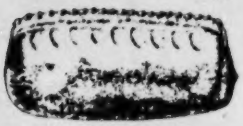
with about 8 subsegments length less than twice width

Supella supellectilium
BROWN-BANDED COCKROACH

with lateral indentations

without lateral indentations

terminal point strong



Periplaneta brunnea
BROWN COCKROACH

terminal point weak

Periplaneta fuliginosa
SMOKY-BROWN COCKROACH

not symmetrical

Blatta orientalis
ORIENTAL COCKROACH

symmetrical

length more than twice width

Periplaneta australasiae
AUSTRALIAN COCKROACH

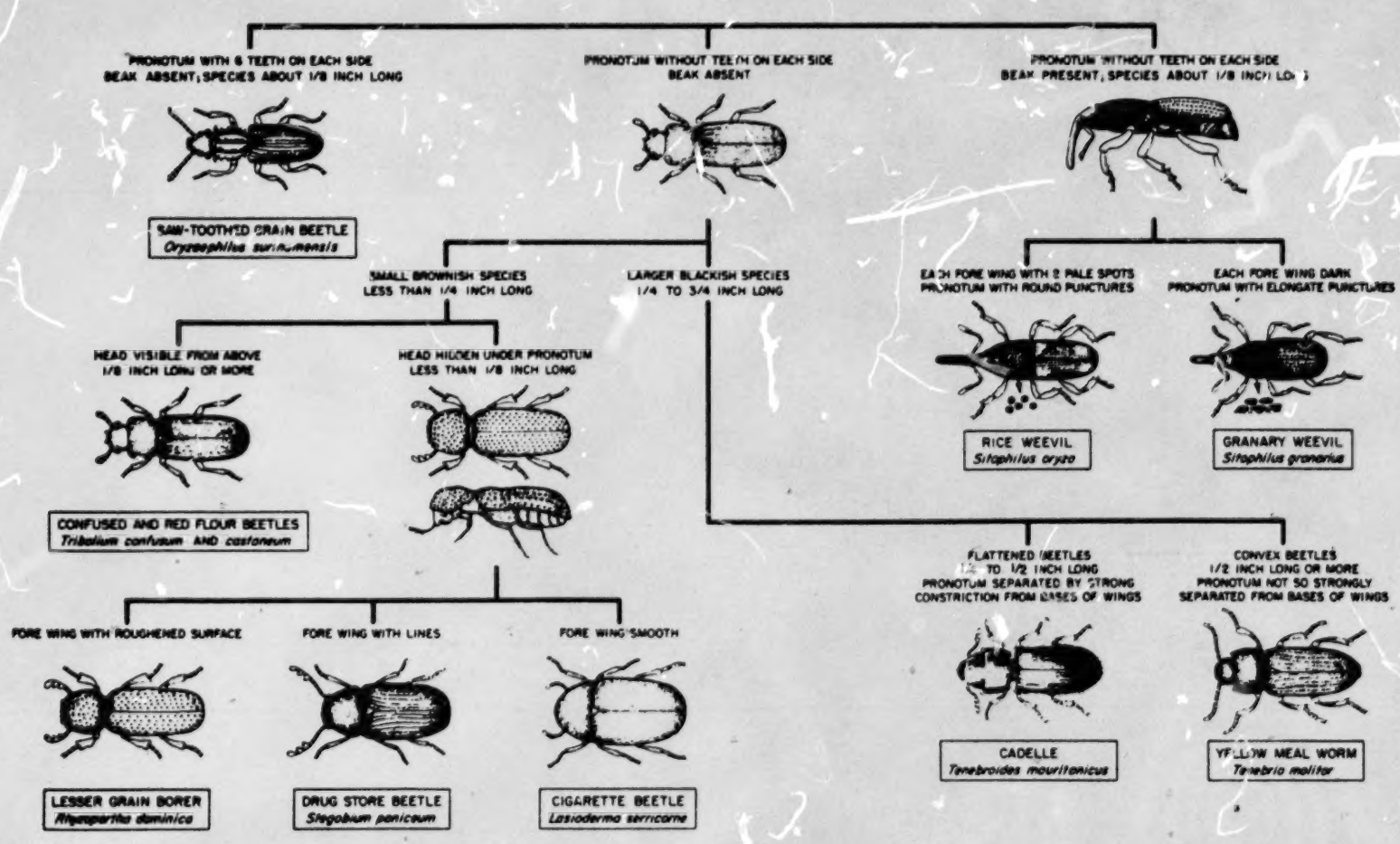
length less than twice width

Periplaneta americana
AMERICAN COCKROACH

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
Communicable Disease Center, Training Branch
Atlanta, Georgia – 1965

BEETLES: PICTORIAL KEY TO SOME SPECIES COMMONLY ASSOCIATED WITH STORED FOODS

Harry D. Pratt

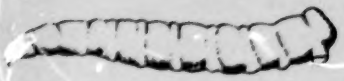


HUMAN ECTOPARASITES: KEY TO COMMON GROUPS

Chester J. Stojanovich and Harold George Scott

legs absent

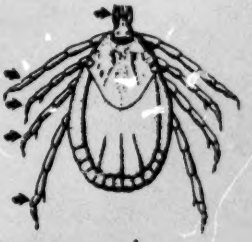
legs present



FLY LARVA
Order Diptera

head definite
3 pairs of legs

head indefinite
4 pairs of legs

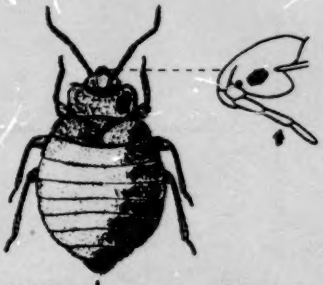


flattened laterally

flattened dorsoventrally

FLEA
Order Siphonaptera

beak jointed



beak not jointed

wings present

wings absent

mouthparts projected

mouthparts retracted

KISSING BUG
Order Hemiptera

BED BUG
Order Hemiptera

LOUSE-FLY
Order Diptera

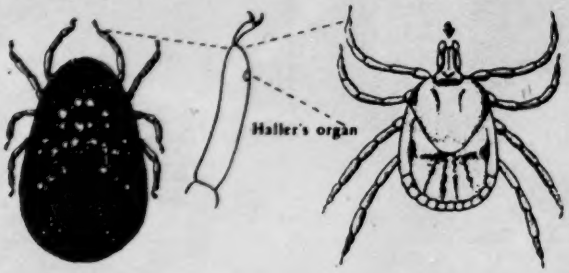
LOUSE
Order Anoplura

over 4 mm. long; Haller's organ present

under 4mm. long; Haller's organ absent

mouthparts ventral

mouthparts anterior



SOFT TICK
Order Acarina

HARD TICK
Order Acarina

MITE
Order Acarina

DOMESTIC FLIES: PICTORIAL KEY TO COMMON SPECIES

Harold George Scott and Margery R. Borom

thorax dull, abdomen dull

thorax dull, abdomen shiny

Calliphora spp. and *Cynomyopsis* spp.
BLUE BOTTLE FLIES

thorax shiny, abdomen shiny

small (about 1/5-inch long)
4 thoracic stripes, indistinct

Fannia spp.
LESSER HOUSE FLIES

medium-size (about ¼ inch long)
4 thoracic stripes, often indistinct

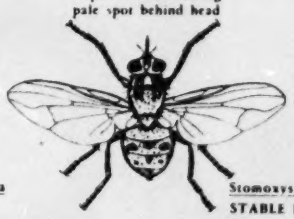
large (usually over 1/5-inch long)
3 distinct thoracic stripes
abdomen with red tip

Sarcophaga spp.
FLESH FLIES

thoracic stripes distinct
sides of abdomen pale
erect when resting
thorax without pale spots

Musca domestica
HOUSE FLY

"squars" when resting
pale spot behind head



Stomoxys calcitrans
STABLE FLY

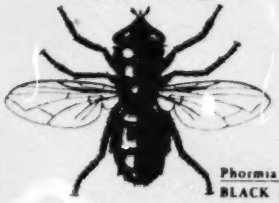
thoracic stripes indistinct
sides of abdomen dark
erect when resting
pale spot on scutellum

Muscina spp.
FALSE STABLE FLIES

color black
medium-size (⅜-inch long)

Ophyra spp.
DUMP FLIES

color dark blue
large (1/3-inch long)



Phormia regina
BLACK BLOW FLY

color green to bronze

color green

3 thoracic stripes

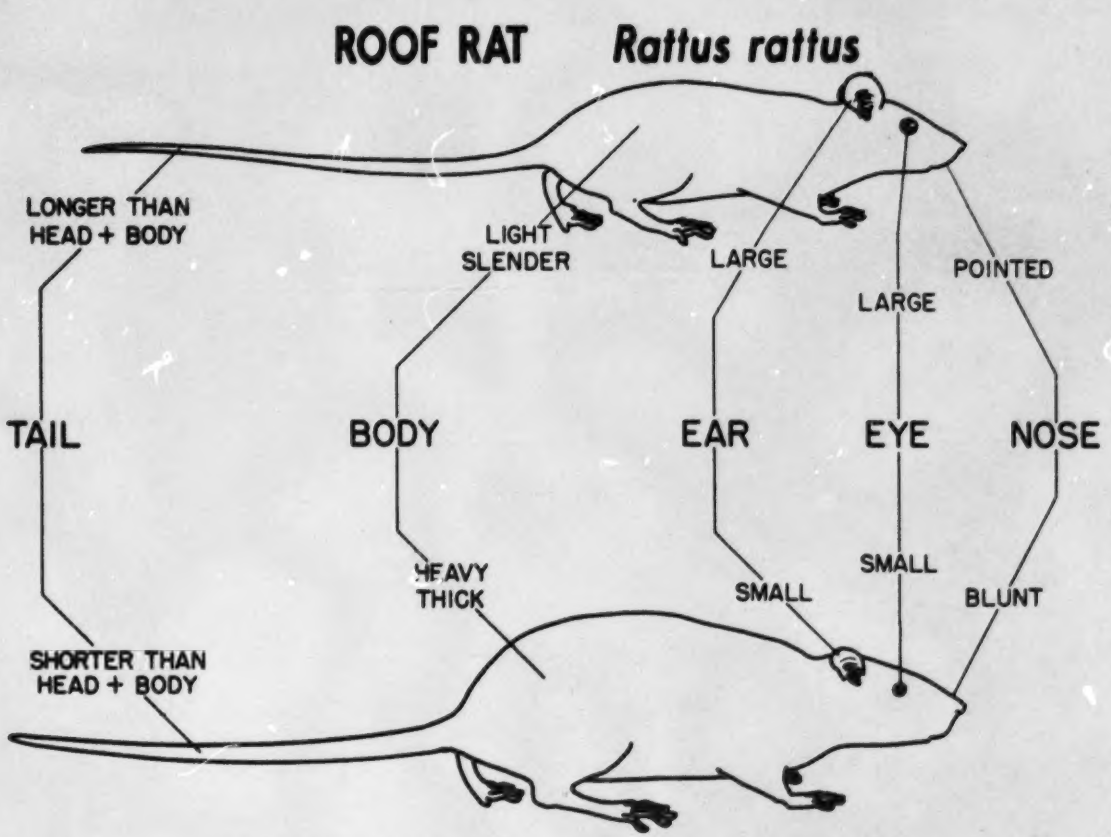
Cochliomyia macellaria
SECONDARY
SCREW WORM FLY

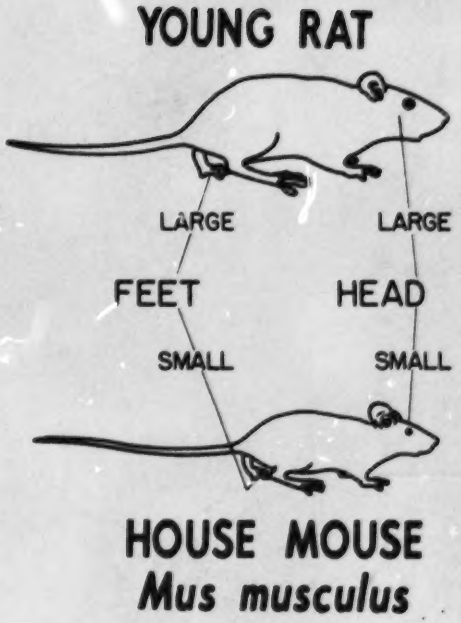
without thoracic stripes

Phaenicia sericata
GREEN
BOTTLE FLY

color bronze
without thoracic stripes

Phaenicia cuprina
BRONZE
BOTTLE FLY


ROOF RAT Rattus rattus
LONGER THAN HEAD + BODY
LIGHT SLENDER
LARGE
LARGE
POINTED
TAIL
BODY
EAR
EYE
NOSE
HEAVY THICK
SMALL
SMALL
BLUNT
SHORTER THAN HEAD + BODY
NORWAY RAT Rattus norvegicus


YOUNG RAT
LARGE
LARGE
FEET
HEAD
SMALL
SMALL
HOUSE MOUSE
Mus musculus